

F4 The air around us

Learn about:

- Identifying mixtures and pure substances
- Separating air

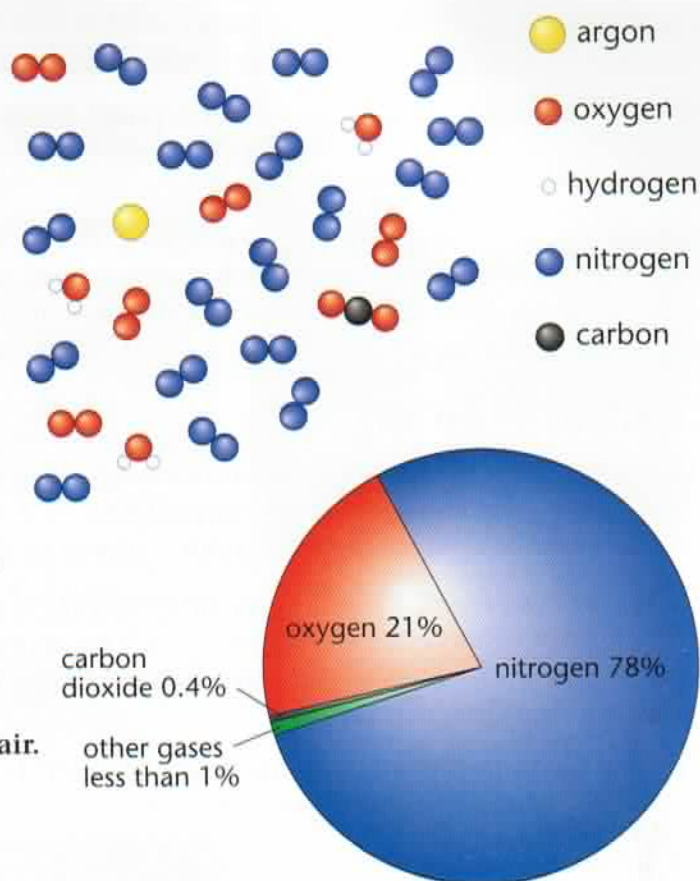
What's in air?

Air is a mixture of nitrogen, oxygen and other gases. The particles in air are shown in the diagram on the right and the proportions of the different substances in air are shown in the pie chart.

Air does not always contain exactly the amounts shown in the pie chart. Air near a bonfire will contain more carbon dioxide and some smoke. Air in a meadow will contain the chemicals made by flowers to attract bees.

The air in a crowded lift will contain less oxygen than in an empty lift because the people will be taking oxygen out of the air. Air varies, it does not have a fixed composition. This is because it is a mixture.

- Which particles in air are:
 - molecules?
 - single atoms?
- Use the pie chart to describe the composition of air.
- Explain how air can vary from the composition shown in the pie chart.



Pure or mixture?

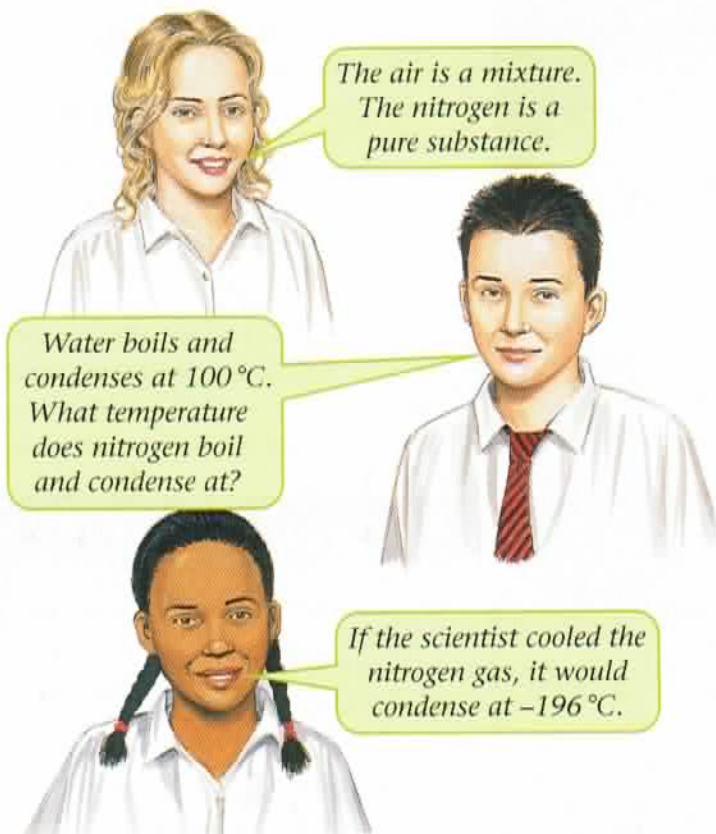
Mrs McMichael sets her class a challenge. She asks them to find out how a scientist could tell the difference between air and nitrogen.

Kevin finds out that pure substances boil at one temperature, the boiling point, and melt at another temperature, the melting point.

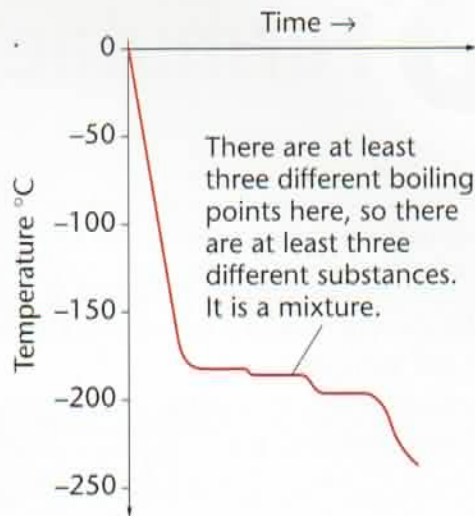
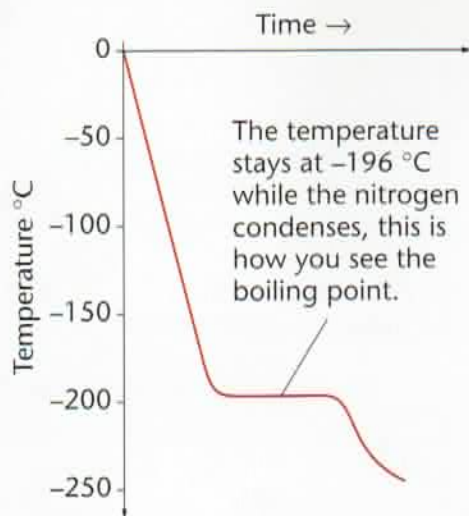
Ellie looks up the boiling point of nitrogen. It is -196°C .

They then think what would happen with the air. The air contains mostly nitrogen and oxygen. The boiling point of oxygen is -183°C . They imagine the scientist cooling the air. When you cool a gas it will condense into a liquid. So, when you cool the air the oxygen would condense at -183°C . Then the nitrogen would condense at -196°C .

They go on an 'Ask the scientist' website to check their idea. The scientist, Dr Taylor, sends back the graphs at the top of the next page.



- 1** Explain how cooling the gases can be used to tell air and nitrogen apart.
- 2** Why does Dr Taylor say 'at least three different substances' rather than 'three different substances'?



Separating air

In hospitals oxygen is added to the air to make it easier for some patients to breathe. Pure oxygen is made by cooling air to -200°C . This means all the nitrogen and all the oxygen will have condensed. It will be liquid air.

The liquid air is then heated up. The nitrogen boils first. All the nitrogen boils away. The oxygen boils next, making oxygen gas.

This is a type of distillation. It is carried out on a very large scale to make all the oxygen we need in hospitals and in industry.

Nitrogen is also very useful. Liquid nitrogen is used to keep things very, very cold. Cells kept at -200°C stay almost perfect. Embryos kept in liquid nitrogen for years can be defrosted and go on to become healthy babies.

- 3** During the distillation of air, at what temperature does:
- the nitrogen boil?
 - the oxygen boil?

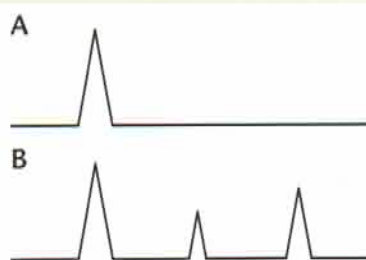


This machine concentrates oxygen from the air to treat the patient.

Questions

- 1** Lesley and Clare find out about a different way of telling which gas is air and which is nitrogen. They find out about a 'gas chromatography' machine. This separates the gases in the mixture, like chromatography uses paper to separate coloured dyes.

This diagram shows the results of putting two gases through the 'gas chromatography' machine.



- Which gas is nitrogen and which is air?
 - Explain how you came to your decision.
- 2** Use the information on these two pages to give as full an answer as you can:
- How do we separate air?
 - Why do we separate air?

For your notes:

- Pure substances melt and freeze at one temperature, the melting point. They boil and condense at one temperature, the boiling point.
- Mixtures change state over a range of temperatures.